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# DIMENSIONS

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# DIMENSIONS

NBS

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**COVER:** Modern technology has put many new products at the disposal of law enforcement and criminal justice agencies. However, many of these groups have neither the financial nor the technical capability to evaluate the appropriateness of specific products for their use. The Law Enforcement Standards Laboratory at the National Bureau of Standards exists to coordinate the establishment of standards for equipment to be used by these agencies and to provide them with technical assistance.

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The Institute for Applied Technology  
The Institute for Computer Sciences and Technology

Center for Radiation Research  
Center for Building Technology  
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by Jacob J. Diamond\*

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# THE LAW ENFORCEMENT STANDARDS LABORATORY

IN 1967, the Law Enforcement Standards Laboratory (LESL) was just a suggestion printed in a committee report. The suggestion was taken up and further developed through the initiative of the National Institute of Law Enforcement and Criminal Justice (NILECJ) and, as a result, LESL was formally established at the National Bureau of Standards in January 1971. Today, 4 years later, LESL is busily engaged in a complex program comprising about 95 active projects for three sponsors. It has already completed over 45 projects.

It was in its 1967 summary report entitled, "The Challenge of Crime in a Free Society," that the President's Commission on Law Enforcement and Administration of Justice first suggested the establishment of an organization such as LESL. The Commission recommended that, "A Federal agency should be assigned to coordinate the establishment of standards for equipment to be used by

*turn page*

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\*Mr. Diamond is chief of the Law Enforcement Standards Laboratory at the National Bureau of Standards.





## **LABORATORY** *continued*

criminal justice agencies, and to provide those agencies with technical assistance. This organization should be an adjunct to an existing Federal agency already technically strong and familiar with standardization problems. The National Bureau of Standards is one such agency."

At the request of NILECJ, NBS studied the feasibility of setting up such a program and, in October 1970, recommended that it be done. LESL was established in January 1971 through a Memorandum of Understanding and an Interagency Agreement between NBS and the Law Enforcement Assistance Administration. The action was endorsed by an exchange of letters between the Secretary of Commerce and the Attorney General.

### **LESL Mission**

Through the use of science and technology, LESL aids law enforcement and criminal justice agencies in the selection and procurement of equipment that is suited to their needs. To accomplish this, LESL performs laboratory research on the performance of law enforcement equipment. LESL activities include:

- Laboratory testing and evaluation of the performance of law enforcement equipment.
- Development of methods for measuring the performance of this equipment.
- Preparation of performance standards, user guidelines and a variety of reports on the equipment.
- Service as a quick-response laboratory facility for the investigation of

problems in law enforcement equipment technology.

### **LESL Organization**

LESL was established at NBS because of the latter's eminence as the national standards laboratory and because of its facilities, personnel and expertise in a broad range of sciences and technologies.

To enable it to utilize more effectively the Bureau's expertise in the accomplishment of its mission, LESL is organized on the Program Manager principle. LESL itself has no laboratories. It operates as a management group for establishing projects within NBS using existing facilities. NBS scientists, engineers and technicians are assigned to LESL projects on an ad-hoc basis.

Some projects are performed outside NBS, usually when the required facilities or personnel are not available within NBS. While most of this out-of-house work is performed at other Federal government facilities, some is done in the private sector.

LESL is an administrative unit in the Bureau's Institute for Applied Technology (IAT). It recently joined with the Office of Consumer Product Safety, the Product Engineering Division and the Product Systems Analysis Division to form the Center for Consumer Product Technology within IAT.

### **LESL Programs**

There are seven senior and assistant program managers on the LESL staff, each with management responsibility for a particular program area. Marshall J. Treado heads the Communications Systems program, LESL's largest. The other major LESL programs are the Security Sys-



tems program, managed by Lawrence K. Eliason; the Investigative Aids program under Robert M. Mills; and the Protective Equipment program headed by Ronald C. Dobbyn.

LESL has smaller programs in Courtroom Equipment (Raymond L. Falge), Vehicles (Jared J. Collard) and Selected Systems (Avery T. Horton).

While NILECJ continues to supply the major funding for LESL's activities—over 92 percent, the National Highway Traffic Safety Administration and the Defense Nuclear Agency now support small programs. These are concerned with breath alcohol analysis equipment and forced-entry deterrent systems, respectively.

## Accomplishments

Since its inception, the LESL program has involved a total of 142 projects. To date forty-nine of these have been completed while 93 are still in progress. The finished products of LESL's activities comprise 18 performance standards, 2 standard reference materials, 1 user guideline and some 28 reports. □

## STANDARDS

- NILECJ-STD-0101.00, March 1972. Ballistic Resistance of Police Body Armor (Stock No. 2700-0155; Price 25 cents).
- NILECJ-STD-0102.00, March 1973. Hearing Protectors for Use on Firing Ranges (Stock No. 2700-00182; Price 40 cents).
- NILECJ-STD-0103.00, May 1974. Portable Ballistic Shields (Stock No. 2700-00253; Price 55 cents).
- NILECJ-STD-0104.00, June 1974. Riot Helmets (in press).
- NILECJ-STD-0201.00, September 1974. Fixed and Base Station FM Transmitters (in press).
- NILECJ-STD-0202.00, June 1974. Mobile FM Transmitters (in press).
- NILECJ-STD-0203.00, October 1974. Personal/Portable FM Transmitters (in press).
- NILECJ-STD-0205.00, May 1974. Mobile Antennas (Stock No. 2700-00250; Price approximately 60 cents).

- NILECJ-STD-0301.00, March 1974. Magnetic Switches for Burglar Alarm Systems (Stock No. 2700-00238; Price 65 cents).
- NILECJ-STD-0302.00, May 1974. Mechanically Actuated Switches for Burglar Alarm Systems (Stock No. 2700-00258; Price 55 cents).
- NILECJ-STD-0303.00, May 1974. Mercury Switches for Burglar Alarm Systems (Stock No. 2700-00254; Price 55 cents).
- NILECJ-STD-0307.00, October 1974. Metallic Handcuffs (in press).
- NILECJ-STD-0601.00, June 1974. Walk-Through Metal Detectors for Use in Weapons Detection (Stock No. 2700-00256; Price 65 cents).
- NILECJ-STD-0602.00, July 1974. Hand-Held Metal Detectors for Use in Weapons Detection (in press).
- NHTSA-STD-2001.00, October 1973. Evidential Breath Testers for Alcohol Content.\*

## REPORTS

- LESP-RPT-0001.00, March 1974. LEAA Police Equipment Survey of 1972, Volume I: The Need for Standards—Priorities for Police Equipment (in press).
- LESP-RPT-0002.00, May 1974. LEAA Police Equipment Survey of 1972, Volume II: Communications Equipment and Supplies (in press).
- LESP-RPT-0003.00, June 1974. LEAA Police Equipment Survey of 1972, Volume III: Sirens and Emergency Warning Lights (in press).
- LESP-RPT-0004.00, July 1974. LEAA Police Equipment Survey of 1972, Volume IV: Alarms, Security Equipment, Surveillance Equipment (in press).
- LESP-RPT-0005.00, July 1974. LEAA Police Equipment Survey of 1972, Volume V: Handguns and Handgun Ammunition (in press).
- LESP-RPT-0006.00, June 1974. LEAA Police Equipment Survey of 1972, Volume VI: Body Armor and Confiscated Weapons (in press).
- LESP-RPT-0007.00, April 1974. LEAA Police Equipment Survey of 1972, Volume VII: Patrolcars (in press).
- LESP-RPT-0201.00, May 1972. Batteries Used with Law Enforcement Communications Equipment: Comparison and Performance Characteristics (Stock No. 2700-0156; Price 50 cents).
- LESP-RPT-0202.00, June 1973. Batteries used with Law Enforcement Communications Equipment: Chargers and Charging Techniques (Stock No. 2700-00216; Price 80 cents).
- LESP-RPT-0203.00, June 1973. Technical Terms and Definitions used with Law Enforcement Communications Equipment (Radio Antennas, Transmitters, and Receivers) (Stock No. 2700-00214; Price \$1.55).
- LESP-RPT-0204.00, May 1974. Voice Privacy Equipment for Law Enforcement Communications Systems (Stock No. 2700-00260; Price 65 cents).
- LESP-RPT-0205.00, July 1974. Automatic Vehicle Location Techniques for Law Enforcement Use (in press).

- LESP-RPT-0206.00, June 1974. Repeaters for Law Enforcement Communication Systems (in press).
- LESP-RPT-0301.00, June 1974. Survey of Image Quality Criteria for Passive Night Vision Devices (Stock No. 2700-00259; Price 60 cents).
- LESP-RPT-0302.00, July 1974. Test Procedures for Night Vision Devices (Stock No. 2700-00257; Price 65 cents).
- LESP-RPT-0303.00, May 1974. Image Quality Criterion for Identification of Faces (Stock No. 2700-00261; Price 65 cents).
- LESP-RPT-0304.00, May 1974. Simplified Procedures for Evaluating the Image Quality of Objective Lenses for Night Vision Devices (Stock No. 2700-00255; Price 60 cents).
- LESP-RPT-0305.00, October 1974. Terms and Definitions for Intrusion Alarm Systems (in press).
- LESP-RPT-0401.00, March 1974. Terms and Definitions for Police Patrol Cars (Stock No. 2700-00252; Price 60 cents).
- LESP-RPT-0501.00, May 1972. Emergency Vehicle Warning Devices—Interim Review of the State-of-the-Art Relative to Performance Standards.
- LESP-RPT-0502.00, July 1974. Summary Report on Emergency Vehicle Sirens (in press).
- LESP-RPT-0701.00, May 1974. Life Cycle Costing Techniques Applicable to Law Enforcement Facilities (in press).
- NBS Technical Note 752, June 1973. Directory of Law Enforcement and Criminal Justice Associations and Research Centers.

## GUIDELINES

- NILECJ-GUIDE-0301.00, April 1974. Selection and Application Guide to Fixed Surveillance Cameras (in press).

## REFERENCE MATERIALS\*\*

- SRM 1820. September 1974. Refractive Index Glass; a Standard Reference Material of the National Bureau of Standards; \$59 per unit.

Order publications for which a price is indicated by title and stock number from the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. Enclose remittance.

Single copies may be obtained from the National Criminal Justice Reference Service, Law Enforcement Assistance Administration, U. S. Department of Justice, Washington, D. C. 20530.  
\* Printed in the Federal Register, Vol. 38, Number 212, pp. 30459-30463 (November 5, 1973). Single copies may be obtained from the Law Enforcement Standards Laboratory, National Bureau of Standards, Washington, D. C. 20234.

\*\* Orders and requests for information should be directed to the Office of Standard Reference Materials, Room B311 Chemistry Building, National Bureau of Standards, Washington, D.C. 20234.



# SAFER STREETS

## THROUGH IMPROVED COMMUNICATION

by Marshall Treado\*

**T**HE policemen of today have benefited greatly from the technology developed for other uses within this country. Nowhere is this more evident than in the field of communications. Law enforcement agencies are now purchasing lightweight radios, mobile digital terminals, automatic vehicle location equipment and miniature transmitters and receivers. They are automatically transmitting and receiving data from computers located at all levels of government, that is, local, state and Federal.

This influx of new and highly sophisticated electronics equipment has created a need for equipment performance standards and a means of disseminating technical information to non-technical personnel. This need was noted in 1967 by the President's Commission on Law Enforcement and Administration of Justice, which said, "Standardization of police mobile equipment should contribute substantially to field efficiency." The Commission then went on to recommend that a program of nationwide

standardization of police mobile radio equipment be established.

Such a program, the development of standards for law enforcement communications equipment, is presently being pursued by the Law Enforcement Standards Laboratory (LESL) at the National Bureau of Standards. In addition to standards, LESL is developing reports and guidelines to assist the law enforcement community in the selection and procurement of communications equipment.

How are these documents generated? Generally, they are produced only after laboratory and/or field testing of a representative number of items of equipment being offered to police for their use. In some cases, the tests are an update of tried and true methods. In others, new test methods have been developed to keep pace with new and more sophisticated electronics equipment being used by policemen. Within NBS, this testing—and subsequent generation of communications equipment documents—is accomplished primarily by the Electromagnetics Division located in Boulder, Colo.

### Standards Needed

As reported in the LEAA Police Equipment Survey of 1972, the three communications items most named as needing standards were mobile radios, portable radios and batteries. Voluntary performance standards are being developed in these areas, as well as for base station equipment, personal transceivers, repeaters, transmitters used in undercover work and mobile digital communications equipment.

Guidelines and reports are being written that cover these areas as well as voice privacy equipment, automatic vehicle location techniques and electronic eavesdropping equipment. These documents should provide the law enforcement community with both the technical and non-technical information to purchase and utilize new and improved communications equipment.

Use of this better equipment ought to mean more reliable communications with a subsequent improvement in emergency help. It should provide an increased number of transmissions, improved communications security, better response times and improved safety for both the police officer and the general public. □

\* Mr. Treado is manager of the Communication Systems Program within NBS' Law Enforcement Standards Laboratory.



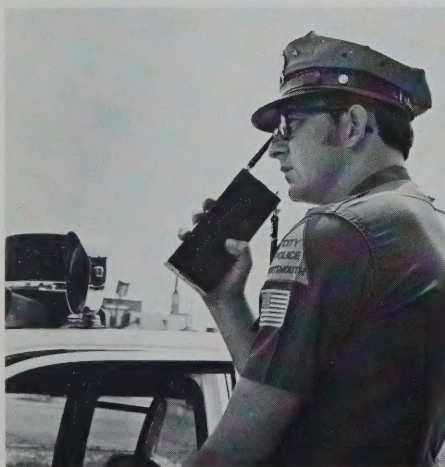


Photo courtesy Metropolitan Police Department, Washington, D.C.



# GUIDELINES

## FOR KEEPING BETTER COURT RECORDS

by Raymond L. Falge\*

**T**HE Law Enforcement Standards Laboratory (LESL) at the National Bureau of Standards, under the sponsorship of the National Institute of Law Enforcement and Criminal Justice, is producing performance standards and user guidelines for tape recorders used with audio and video equipment by court systems. The technology of these devices is new to many courts. Therefore, guidelines as well as performance standards are needed for purchasing equipment.

Also military and some state courts found that qualified stenographic court reporters were often unavailable. Consequently, another method of preserving court records was needed. With careful planning, audio tape recording can be a viable economic alternative as well as a more accurate method of record preservation.

### Economical, Accurate

The major factor reducing the cost of keeping the record is that a less skilled person is required to operate a tape recorder than is required to use a stenotype machine. Prolonged training is needed to develop the unique skills of stenotypists. When these highly qualified people are not

required to be in the courtroom a significant economy should result.

Typed transcripts may be produced from the audio tape record at somewhat more cost in manhours than stenotype records. However, the substantial improvement in efficiency with audio tape recording results from the advantages gained in the record-taking phase of the operation.

The audio tape system also eliminates delays in transcript production that result from the interpretation of individualistic stenotype notes. With this impediment removed the potential labor force that may be applied to a particular transcript is increased. Transcripts can then be produced at a rate commensurate with need. De-

lays in transcript production are a factor in overall court delay—an item of very high concern.

### Guide

Scientists in the Electromagnetics Division of the National Bureau of Standards in Boulder, Colo., have examined those performance factors of the tape recording/playback devices that influence the overall economy of the record production system. From this they have developed a user guide to help court officials design an efficient system of court recording. They have also developed a set of equipment performance parameters and test methods for measuring these parameters.

\* Dr. Falge heads the Courtroom Equipment Program in NBS' Law Enforcement Standards Laboratory.





## Video Tape

Testimony given in the courtroom may also be preserved by video tape recording, but the potential of this new medium far exceeds its present limited use. The quantity of information recorded is so much better than that of a typed transcript or an audio tape record that this medium may drastically alter the future methods of presenting evidence and testimony to a jury at trial.

The use of depositions has long been avoided by attorneys since the impact of witnesses so presented is noticeably reduced. When depositions are presented on video tape, the impact of the deposition is measurably enhanced, and the demeanor of the witness as well as his actual testimony are accurately recorded. Therefore, the need for a witness to appear in court before a jury is reduced. In fact, the major portion of a trial may be recorded for subsequent presentation to a jury.

If the rights of the defendant (or both parties in a civil action) to a fair trial and to confront accusers can be preserved, a large number of inter-related benefits may accrue from the use of this medium. Testimony may be taken earlier and at a greater convenience to the witness. Thus when testimony is taken earlier it will be fresher and clearer in the witness' mind. In certain criminal trials where it is dangerous to be a witness, the safety of the witness can be better protected. For the great majority of witnesses, the additional convenience of giving testimony by video should make the citizen-witness more satisfied with his court system and cause him to be less reluctant to become a witness.

## LESL Involvement

The Law Enforcement Standards Laboratory at NBS is currently reviewing and evaluating the factors that determine the quality of a video image. These factors include:

- The resolution or, more completely, the modulation transfer function.
- The contrast which is related to the background and the noise.
- The spectral sensitivity of the camera type.
- The distortion of the system.

When this study is completed, LESL plans to issue performance requirements and user guides to help court officials obtain the maximum benefits from video tape recording. □



*Tape recorders used with audio and video equipment are being employed in courts to reduce the cost and increase the efficiency of record keeping.*



*NBS is studying the performance of video tape systems and expects to produce performance requirements and user guides.*



# HELPING IMPROVE POLICE PROTECTION

by Ronald C. Dobbyn\*



*Standards have been promulgated for hearing protectors used by police on firing ranges.*



*NBS is providing technical guidance in the selection of handgun ammunition.*

**P**ROVIDING protection to policemen is a major industry today. Recent surveys suggest that law enforcement agencies in the United States will spend over \$17 million for body armor alone over the next 5 years. What will they be buying? The National Bureau of Standards' Law Enforcement Standards Laboratory (LESL) answers that question by developing for the National Institute of Law Enforcement and Criminal Justice (NILECJ) safety and performance requirements for police protective equipment.

## The Beginning

LESL's program in law enforcement protective equipment began with a laboratory investigation of police body armor early in 1971. This work identified the important performance characteristics of body armor, developed methods to test these attributes and produced a standard for the "Ballistic Resistance of Police Body Armor."

Until then, there were no standards for this equipment. Law enforcement agencies either had to accept the salesman's appraisal of his products or attempt to evaluate the prospective armors themselves—a task that many are neither technically nor financially equipped to do.

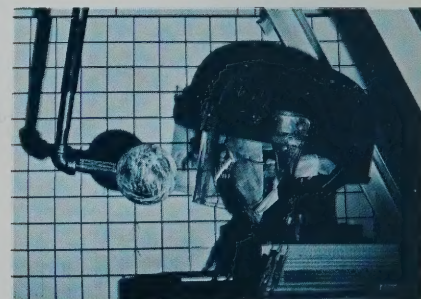
The same was also true for helmets, ballistic shields, tear gas masks, hearing protectors and face shields. Today LESL has active projects in each of these equipment areas. The program is also currently studying the problems associated with handgun ammunition, tear gas devices and the safety of police firearms ranges.

LESL's goal is to develop, as rapidly as possible, performance standards, guidelines and reports, each based on in-depth, comprehensive laboratory evaluations of as many models or brands as is feasible. The products are tested and evaluated on the basis of their intended use by the law enforcement community. The project that produced the riot helmet standard illustrates one approach that LESL has taken.

## One Example

Early in the work on police helmets, LESL found that, of 11 different brands of riot helmets, only two provided the wearer adequate protection. Tests were drawn up to reflect situations that police were likely to encounter. The test levels were based on user information; forces were calculated and translated into performance requirements. In this particular case, new test procedures were not developed, but were adapted from an existing American National Standards Institute standard for protective helmets. The levels of performance, however, were changed as necessary so that they would meet those requirements set forth for law enforcement riot helmets.

*continued on page 67*



*Face shield undergoing impact resistance test.*

\* Mr. Dobbyn is manager of the Protective Equipment Program within NBS' Law Enforcement Standards Laboratory.



# TOWARD MORE OBJECTIVE EVIDENCE

## Support for Forensic Science at NBS

by Robert M. Mills

**T**HE Supreme Court Miranda Decision, which limited authorities in the use of confessions and in other ways of collecting evidence that may infringe upon the rights of the accused, is causing a shift to increased use of physical evidence and scientific investigation by law enforcement officials. Forensic science laboratories are being asked to develop objective information in the investigation and adjudication of criminal offenses. The National Bureau of Standards is helping forensic science laboratories provide the required objectivity through the Investigative Aids Program in the Law Enforcement Standards Laboratory (LESL).

For example, a reference collection of automotive paint colors, described in the September 1974 issue of *DIMENSIONS/NBS*, has been developed at NBS with the cooperation of the auto manufacturers and their paint suppliers. This new auto paint reference collection is designed to aid forensic science laboratories in identifying paint samples collected at the scene of hit-and-run incidents.

The first reference collection consists of samples of approximately 140 paint colors used on 1974 model domestic passenger vehicles. It will soon be enlarged to make chemical

as well as color comparisons possible.

### Identifying Glass Evidence

In other LESL projects, the reliability of glass characterization by means of refractive index measurements and by trace element analysis is being investigated. New and used automobile headlights are being collected and measured. It has been discovered, for example, that refractive index measurements can be used reliably to differentiate newer auto headlights made by one glass manufacturer from older headlights made by the same and other manufacturers. Trace element analysis, on the other hand, shows promise for use in making individualizations of glass evidence.

As a result of these studies, a new standard reference glass sample has been certified by NBS for refractive index values commonly encountered in forensic applications. This standard reference material is now available to forensic scientists for the calibration of their instruments, for the validation of their procedures or for the confirmation of a classification by direct comparison with glass evidence.

### Gunshot Residue, Breath Alcohol Concentrations

Still other investigative aids projects in LESL are concerned with prob-

*Testing for residue left from fired gun.*



lems ranging from the detection of gunshot residue on the hand of a person suspected of firing a gun to the measurement of alcohol concentration in the breath of a suspected drunken driver. More typical of other LESL projects is the work to develop performance standards for metal weapon detectors, for bomb disarmament and parcel screening X-ray systems, for field narcotic test kits and for explosive vapor "sniffers." All of these projects are sponsored by either the National Institute of Law Enforcement and Criminal Justice in the Department of Justice or the National Highway Traffic Safety Administration in the Department of Transportation. □

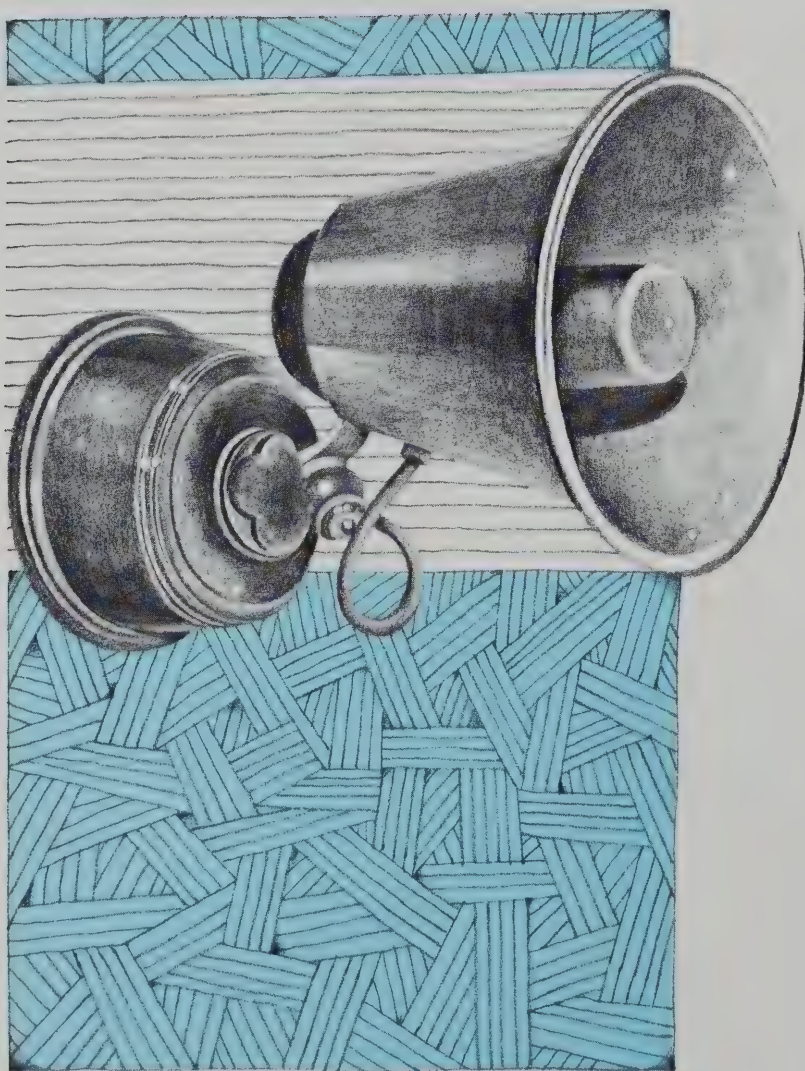
*A suspected drunken driver is having his breath tested for alcohol concentration.*



\* Mr. Mills is the manager of the Investigative Aids Program in NBS' Law Enforcement Standards Laboratory.



# INVESTIGATING THE PERFORMANCE OF SECURITY



by Lawrence K. Eliason\*

**P**ROTECTION of the public depends upon a variety of security measures, ranging from resistance of doors to forced entry to the restraint of apprehended persons. Investigations by the National Bureau of Standards' Law Enforcement Standards Laboratory (LESL) for the National Institute of Law Enforcement and Criminal Justice of the performance of security equipment have uncovered some surprises.

Handcuffs, for example, are familiar items that have been used by police for many years. One would expect that all of the manufacturing and design problems had been solved. However, early in the program to develop a standard for handcuffs, LESL was asked to examine handcuffs purchased by the State of Alabama.

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\* Mr. Eliason is manager of the Security Systems Program within NBS' Law Enforcement Standards Laboratory.







LESL's staff found that they could easily open a cuff with little more than finger pressure. Confronted with hard data concerning the minimum force required to open them, as low as 27 newtons (6 pounds), the manufacturer replaced the entire lot of 800 handcuffs. Since then LESL has developed performance standards, which are currently in press, for metallic handcuffs.

Thumbcuffs were other items of interest. These devices, as the name implies, are miniature cuffs that are applied to the thumbs. In working with these devices, LESL found that restraint could only be obtained when the cuffs were tightened to the point of restricting the blood flow in the thumb. Consultation with the medical profession confirmed that even an individual with normal circulation was in danger of requiring thumb

amputation if restrained with thumbcuffs for more than 1½ hours. The potential harm to apprehended persons is of critical concern. A large number of individuals suffer from circulatory problems that could result in permanent damage to the thumbs if restrained for only a matter of minutes. Needless to say, LESL did not develop a standard for thumbcuffs, and recommends that they not be used under any circumstances.

## Burglar Alarm Systems

Burglary is a major problem today. In 1973, theft from residences exceeded \$500,000,000, and losses to business were in excess of \$250,000,000. While burglar alarm systems are effective in preventing burglary, and result in a much higher apprehension and conviction rate

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Active portable night vision device.

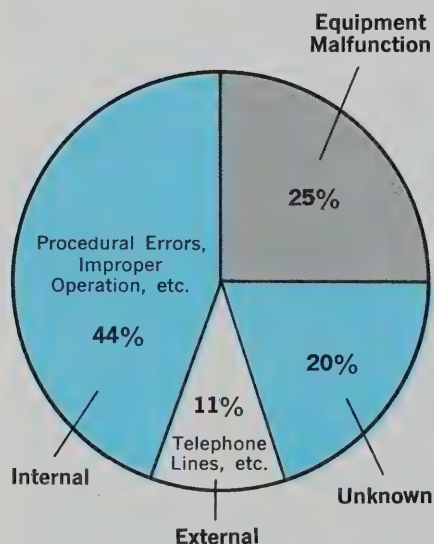


## INVESTIGATING *continued*



than that experienced by unprotected premises, false alarms are a major problem. Many jurisdictions report false alarm rates as high as 99 percent. The LESL effort is directed toward the development of performance standards for burglar alarm systems that will ensure reliable operation with a minimum of false alarms.

The first burglar alarm system components to be investigated were the simple switches: mechanical, magnetic and mercury. Nearly one-third of the commercial switches tested during the laboratory phase of the program failed to meet the performance requirements that are included in the published documents. It was not unusual for a switch to fail after only 50 or 100 operational cycles. The program has now advanced to the development of standards for the more complex sensors, such as microwave and ultrasonic motion detectors, sound sensors and the newer equipment such as passive infrared sensors. LESL is also preparing a catalog of security equipment and a directory of security resources for use by the average citizen in locating manufacturing sources for a variety of security needs. In addition, LESL plans to issue guidelines for burglar alarm system selection and use.



Causes of false alarms.  
AICCC Survey.

experienced individual, without the use of burglar tools. The security of a door assembly depends not only upon the lock, but also on the strike, jamb, hinge, door and even the surrounding wall. The door standard developed by LESL is presently being circulated for external review. This standard, intended to provide protection from crimes of opportunity, includes requirements for four levels of security. These are related to the skill level of the perpetrator and the techniques that those at his skill level normally employ to gain entry. The lowest level included in the standard is representative of the minimum physical security requirement for any residence, while the highest level is that required by small business establishments not of a high risk nature, such as a jewelry store.

### Optical Systems

LESL work in optical systems has resulted in several reports and standards directed toward items of police department use, such as active and passive night vision devices, image quality requirements for identification and the selection of equipment for police photography. It has also resulted in the first LESL guideline, "The Selection and Application of Fixed Surveillance Cameras." This guideline is intended to familiarize the small businessman with the range of equipment available for photographic evidence of shoplifting, employee theft and armed robbery. It discusses the basis for determining needs for such equipment, how to select the most appropriate equipment for unique needs, considerations in installing it, estimated acquisition and maintenance costs and tips on using it. □

### Door and Window Security

The physical security of doors and windows is fundamental to burglary resistance. While one would expect to prevent forced entry through the use of a better lock, this is only a small part of the protective system. The typical home built since World War II, particularly those with the popular key-in-knob lock, can be entered, at will, by a relatively in-



# PATROL CAR PERFORMANCE AND SAFETY STUDIED

by Jared J. Collard\*

**T**HE question might be asked: "Why is a program needed to develop standards and guidelines for police vehicles?"

There are two reasons. First, in 1972, the National Institute of Law Enforcement and Criminal Justice (NILECJ) asked the National Bureau of Standards to conduct a comprehensive survey of police equipment. NBS surveyed 1386 police agencies and published its findings in a series of seven reports. One of these reports indicated that the police consider patrolcars as one of their two major equipment problems.

Second, a recent study by NBS' Law Enforcement Standards Laboratory (LESL) estimated that there are approximately 160,000 patrolcars in use (marked and unmarked) in the United States and that nearly 60,000 new units are purchased annually. The gross cost of these new purchases is about \$210 million; the net cost is between \$125 and \$150 million, after trade-in or resale of the patrolcars being replaced. Except for the cost of law enforcement facilities and personnel salaries, vehicle purchase and maintenance is the largest item in police budgets.

Two projects were undertaken by (LESL) in FY 1973 as preliminary to a full-scale effort to develop performance standards for patrolcars.

## Patrolcar Survey

A patrolcar state-of-the-art study was conducted by Robert G. Massey of NBS. This study investigated the functions of the patrolcar and examined the various systems of the

vehicle, as they affect the performance of the patrol functions.

The study also analyzed the patrolcar market—what the automobile industry offers in the way of patrolcar technology, and what the police are purchasing. Massey found that the police, often pinched by budgeting constraints or confused by apparent similarities in patrolcar options and accessories, may not always purchase the best vehicle for their use.

## Life-Cycle Costing

Rosalie T. Ruegg, also of NBS, conducted a police patrolcar life-cycle costing study. In her study, Ruegg attempted to answer such questions as: "What is the effect of accessorization or resale value?" "Should departments maintain their own repair facilities, use dealer repair shops or contract for repair services?" "How

often should patrolcars be replaced?" And, "What are the cost/benefits of the personal patrolcar assignment program?"

Ruegg's report, to be published soon, analyzes operating and maintenance costs for cars of different size, used at different rates, in different environments and discusses methods of cost reduction. She has developed mathematical models dealing with time of replacement. The report also discusses methods for obtaining the highest resale or trade-in values.

The future direction of the new police vehicle program in the Law Enforcement Standards Laboratory will be toward the development of better methods of testing and measuring the performance of patrolcars, the improvement of various subsystems of the vehicles and improving overall patrolcar safety. □

*Testing brakes on police vehicle for performance under emergency conditions.*



\* Mr. Collard heads the Police Vehicles Program in NBS' Law Enforcement Standards Laboratory.



# HIGHLIGHTS

## New Environmental Standards

NBS has completed development of five nitric oxide in nitrogen Standard Reference Materials (SRM's), which provide standards needed by the Environmental Protection Agency to monitor compliance with automotive emission laws.

This is the fourth series of SRM's prepared for this purpose. The other series are: propane in air, carbon dioxide in nitrogen and carbon monoxide in nitrogen. For information, write the Office of Standard Reference Materials, B311 Chemistry Building, NBS, Washington, D.C. 20234.

## Metric Slide Show

"What About Metric," a new slide-tape presentation from NBS, is now available for sale to the business community and the general public. The 7-minute program presents basic factors involved in metric conversion as an aid to companies contemplating the changeover. Although this show is primarily business-oriented, it can benefit a broader range of audiences, including consumer and educational organizations.

The presentation includes a set of 70 slides, a programmed audiocassette and a script. It is available from the National Audio Visual Center (GSA), Washington, D.C. 20409—Attention Order Department for \$12.

## Testing Gypsum Wallboard

NBS has developed a test method to determine which fire resistant gypsum wallboard has sufficient properties to be rated as Type X. More than 80 percent of all finished wall and ceiling surface materials in the U.S. building construction industry

are gypsum. One-fifth of this 80 percent is special fire resistant wallboard. Type X is the most fire resistant.

This test method provides the gypsum industry with a more efficient and economical technique for determining Type X wallboard than was previously available.

## Data Privacy Symposium

The Federal Privacy Law of 1974 and its implications for society and the individual will be the focus of a symposium/workshop to be held April 2-4, 1975, in McLean, Va.

The symposium/workshop, cosponsored by NBS and the MITRE Corporation, is designed to provide key decision makers with guidelines for exercising rights and fulfilling obligations in areas of privacy. For information, write Grace Burns, A200 Administration Building, NBS, Washington, D.C. 20234. Telephone: 301/921-2731.

## Energy-Related Inventions

President Ford recently signed into law the Federal Nonnuclear Energy Research and Development Act (S. 1283). Section 14 of the Act directs NBS to evaluate all promising energy-related inventions. Particular attention is to be given those inventions submitted by individual inventors and small companies for grants from the Energy Research and Development Administration.

## NBS to Exhibit Calibration System

At the IEEE International Convention in New York City, April 8-10, 1975, NBS will demonstrate its new system for the calibration of oscillators. NBS will offer complete circuit

and hardware details to interested individuals and manufacturers.

This system uses atomically controlled frequency signals from the three major television networks to provide fast, accurate calibrations of oscillators. In addition, the system is directly traceable to the NBS frequency standard.

## New Structured Programming Language

NBS has developed a structured programming language called STAPLE for the scientific community. To improve the effective utilization of computers, NBS modified FORTRAN to include block structure programming concepts, replacing the traditional "go to" statements. Structured programming makes it easier to write and debug computer programs, and the finished program is more comprehensible and more adaptable to other purposes.

## Measuring Water/Air Pollution

The Office of Air and Water Measurement has replaced the Measures for Air Quality Program at NBS. James R. McNesby heads the Office. Radford Byerly is air program manager and William Kirchhoff is water program manager. Increasing emphasis on water studies was cited as the major reason for the change.

The new unit is the focal point for a Bureau-wide program aimed at developing and improving the measurement of environmental pollutants. The Office also supports the evaluation of data and generation of physical and chemical parameters which describe the formation and spread of pollutants. □



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## New Flowchart Template for Federal Computer Users

**A** new template for use in documenting computer systems and programs has been developed and field tested by the National Bureau of Standards' Institute for Computer Sciences and Technology (ICST).

The NBS template has both large and regular-sized representations of the most commonly used symbols, making it more convenient to use for long annotations than other templates currently in use.

The template was developed to facilitate the implementation of the Federal Information Processing Standard for Flowchart Symbols and Their Usage in Information Processing (FIPS 24), which was approved for Federal use in 1973. Unlike existing templates, the new template provides all the symbols specified in the standard and maintains the proper dimensional ratios as well.

A prototype of the template was field tested by NBS in cooperation with the systems support staff of the General Services Administration's Automated Data and Telecommunications Service.

The availability of the new template will facilitate the use of the standard and should materially contribute to improved documentation of Federal computer systems and programs.

In a 1974 report to the Congress, the Comptroller of the United States cited that the Federal Government was not adequately or effectively documenting its computer-based systems. The report said this was contributing to increased government costs for systems maintenance and was a significant factor limiting the extended use of computer software through interagency sharing of developed programs and systems.

The new template is one of several standards efforts being undertaken to improve ADP documentation. Other efforts include the development of standards for software summaries which are used to abstract conveniently the basic characteristics of software products and to facilitate the identification of systems and programs for interagency sharing. This aspect has been standardized in FIPS PUB 30.

FIPS PUB 11 provides a standard vocabulary of information processing terms. A guideline for describing and documenting data interchange formats is contained in FIPS PUB 20, which is also adopted for use as a voluntary industry standard. Continuing efforts are directed toward other documentation standards for use by managers, programmers and operators of computer facilities.

The NBS template is provided with a covering jacket explaining its use in documenting various logical functions and machine processes. It can be ordered using usual government supply procedures as National Stock Number 6675-00-111-0446 at a cost of \$1.95.

The specifications of the template may be obtained from the Office of ADP Standards Management, NBS, Washington, D.C. 20234. Non-government activities can use these specifications in acquiring the template from commercial sources. □



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## Call for Papers Issued for NBS/ANSI Symposium

**P**APERS are being solicited for the second national symposium on the Management of Data Elements in Information Processing.

The symposium, cosponsored by the National Bureau of Standards and the American National Standards Institute's committee on representations of data elements (Committee X3L8), will be held October 23-24, 1975, at NBS in Gaithersburg, Md. Presentations will focus on problems faced by data managers in the design and maintenance of information systems.

Papers should discuss timely data management topics such as human factors in data recording, use of check characters, data element management and benefits in manual systems, word processing and its impact on text and data preparation, communications needs for data standards and standard codes for character and control and their impact on data interchange.

A notification of intent to submit a paper and a brief statement of the paper's main points should be forwarded by April 15, 1975, to David V. Savidge, program chairman, DATRON 8130 Boone Blvd., Vienna, Va. 22180. Telephone: 703/893-2450.

An abstract and first draft of the manuscript are needed by April 30. Authors will be notified of acceptance by May 15, 1975.

Presentations at the NBS/ANSI symposium will highlight techniques to improve the collection, processing and interchange of data. Invited speakers will discuss data management in relation to data security and to the data element directory as a viable tool for data managers.

Registration information can be obtained from Mrs. Hazel McEwen, NBS, Washington, D.C. 20234. □



## Proceedings of Fire Safety Research Symposium Available

**F** LAMMABILITY test methods and the physiological effects of fire are among the topics covered in the recently published proceedings of a major symposium on fire safety research conducted at the National Bureau of Standards.

Included are the texts of 20 papers presented at the symposium in August 1973 by prominent researchers from NBS, private industry, universities, other government agencies and the National Fire Protection Association.

Other subjects presented at the symposium include hazard analysis, standards development, flame chemistry, fire modeling, fire services, effect of fire on building materials and field investigation methods for firefighters.

The papers discuss in detail the development of children's sleepwear flammability standards and mandatory sampling plans, mechanisms of flame retardants, flame spread and radiant panel test methods, contribution of interior finish materials to fire growth, a field study of non-fire-resistive multiple dwelling fires, the Research Applied to National Needs (RANN) program of the National Science Foundation and other related topics.

Printed copies of the proceedings, Fire Safety Research, NBS Special Publication 411 (SD Catalog No. C13.10:411), may be ordered for \$3.10 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. □

## Metric Kit Published

**B**ECAUSE of increasing interest in the metric system, the National Bureau of Standards has just published a concise package of metric information. The Metric Kit should assist teachers, students, businessmen and consumers in understanding and using the metric system of measurement.

The Kit contains:

- A handy, wallet-sized card that converts units of measure into metric units and vice versa.
- A 15-centimeter (6-inch) ruler.
- A copy of "What About Metric," a publication that explains in simple terms all anyone needs to know about using the metric system in daily living.
- A brief history of measurement systems that includes a colorful chart explaining metric.
- A bibliography of metric information, including sources of metric teaching aides for educators.
- An article by Dr. Richard W. Roberts, Director of NBS, that summarizes where we stand in the switch to the metric system of measurement.

Copies of the Metric Kit are available as SD Catalog No. C13.10:40 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The cost is \$2 per kit; a 25 percent discount is offered for orders of 100 or more. □





# New Data on Methane

**T**HE most accurate and comprehensive collection of data available for the properties of methane has been completed by the National Bureau of Standards' Cryogenics Division, Boulder, Colo., and has been published as NBS Technical Note 653.

Methane is the major component of natural gas and LNG (liquefied natural gas). Thus accurate knowledge of methane properties in the gaseous and liquid states is essential for the processes of liquefaction, separation, storage, pumping, transportation and equitable trade of LNG. It is also indispensable for reliability and safety in engineering plant design.

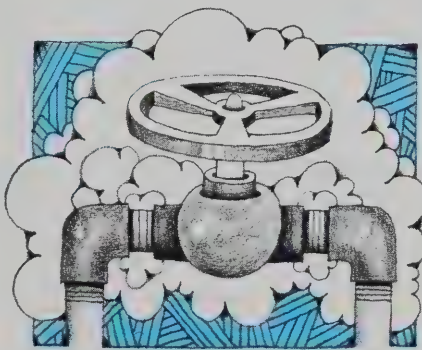
The AGA (American Gas Association)/LNG Committee has recommended that these data be accepted by the AGA and ANSI (American National Standards Institute) as "agreed-on" reference data for the natural gas industry. The data were also proposed for acceptance by the international LNG industry at the 4th International Conference on LNG, in Algiers in June 1974.

Authored by R. D. Goodwin and titled, "The Thermophysical Properties of Methane, from 90 to 500 K at Pressures to 700 Bar," the 280-page publication culminates 3 years of work in acquiring available physical properties data, in performing experimental measurements and in formulating these data for use in thermal computations. Almost all of

these formulations are new—designed to be consistent with critical-point behavior. Where appropriate, they are constrained both at the triple point and at the critical point for consistency in the derived thermodynamic network.

A novel equation of state, having origin on the vapor-liquid coexistence boundary, was employed for the first time. Computations are based almost entirely on ideal gas specific heats and experimental  $P - \rho - T$  (pressure-density-temperature) data via the equation of state, without weighting to data for derived properties. Validity of the equation and method was confirmed by good agreement with such data.

Copies of NBS Technical Note 653 are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at \$2 each, postpaid. Order by SD Catalog No. C13.46:653. □



## PROTECTION *continued*

Since that time several manufacturers have taken a closer look at their helmets. Some have redesigned them; all have expressed an eagerness to produce helmets which will meet the new standard. Yet, most importantly, law enforcement agencies now have a standard that has been written with their requirements in mind and that they can now use in purchasing better and safer riot helmets.

### Continued Improvement Needed

Identifying performance requirements can be a major problem. Police handgun ammunition is a good example of this. Often, test procedures are not available, as was the case with body armor and as it is today for tear gas devices. Yet LESL's investigators have found that the problems are not insurmountable, only a challenge to their ingenuity.

As with most consumer products, law enforcement protective equipment is an ever-changing field. New, improved or substitute materials and increasing knowledge of the relationships of various injuries to their physical cause will require that the standards for protective equipment be continually revised and updated. So, in a sense, LESL is never really finished with any of these products, they just become part of a broader program. □



# Particle Accelerator Facilities Upgraded

**T**HE National Bureau of Standards recently completed an upgrading of its particle accelerator facilities to provide increased support for research into new energy sources, to provide national standards for calibration of instruments to measure hazardous ultraviolet radiation and to support the electronics industry.

Called the Synchrotron Ultraviolet Radiation Facility, or SURF II for short, it is an important source of ultraviolet and soft X-ray radiation for experiments in atomic, molecular and solid-state physics. SURF II is just one of three accelerators being used for synchrotron radiation in the country and the only one in the East. The others are at Stanford and the University of Wisconsin. The Bureau opened its synchrotron radiation facility—the first in the world—in 1961 at the old Washington site and has pioneered in using this radiation for atomic physics.

The heart of the machine is a doughnut-shaped ring, with an 83-centimeter radius, set in a magnetic field. An accelerator shoots an electron beam into the hollow ring at an energy of 10 MeV where it is accelerated up to 240 MeV by an applied voltage. The electron whips around the ring, being turned by the magnetic field. Radiation is produced as

the electron is continually bent away from a straight path into a circle. The radiation is in the form of a narrow beam.

The Bureau upgraded its facilities to obtain a higher intensity of ultraviolet radiation (at least 200 times more intense than SURF I) and shorter wavelengths—down to  $4 \times 10^{-9}$  meter (40 angstroms) compared with  $1 \times 10^{-8}$  meter (100 angstroms) with SURF I. Because of this, SURF II will offer better precision in its calibrations.

SURF II's more stable radiation beam will permit more experiments and over a longer time span than was possible with SURF I. The radiating electron beam can be "captured" in the SURF II ring for several hours, allowing plenty of time for conducting experiments. A total of 11 holes or "ports" at spaced intervals have been made in the SURF II doughnut to permit the radiation beam to be sent down long, narrow tubing—or beam lines—for conducting experiments. Initially, three beam lines capable of handling seven experiments will be opened; the remaining eight beam lines will be opened as needed. As many as 30 simultaneous experiments could then be performed.

## Areas in Research

Experiments in the new facility are underway. The first project is concerned with the calibration of diodes used as radiometric transfer standards. NBS develops and maintains four calibration standards for measuring extreme ultraviolet that are utilized by other government agencies, such as the National Institute of Occupational Safety and Health (NIOSH), the National Aeronautics

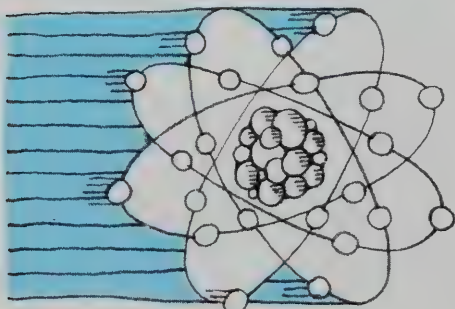
and Space Administration (NASA) and the Air Force.

NIOSH needs the standards to calibrate portable equipment it uses to measure worker-exposure to ultraviolet radiation in such industries as thin-film production, paint curing and the manufacture of mercury-vapor lamps. In the areas of medicine and dentistry, both the technician and the patient need to be protected against UV overdose.

NASA and the Air Force are interested in using NBS standards to calibrate instruments for measuring the sun's ultraviolet radiation and its absorption by the earth's upper atmosphere. Satellite communication blackouts that affect both agencies are caused by sudden radiation flare-ups on the sun's surface. They hope to predict these disturbances in advance.

The NBS synchrotron will also be used in assisting efforts to develop new energy sources for long-term solutions to the energy crisis. Leading researchers in the Controlled Thermonuclear Reaction (CTR) effort at Princeton University and Los Alamos are interested in using SURF II as a standard source to calibrate the diagnostic instruments they use to study the behavior of high-energy plasmas (electrically conducting gases).

Electronics laboratories will either use NBS-calibrated detectors to monitor their industrial production or bring in their own instruments for adjustment. Electronics researchers also want to use extreme ultraviolet's short wavelengths to achieve better resolution and detail in the photographic process of copying circuits from master masks. □





**D**UE to government-wide efforts to reduce operating costs and conserve energy, the Time and Frequency Division of the National Bureau of Standards is currently attempting to determine the extent to which its radio stations, WWV and WWVH, are used. Through the following questionnaire, NBS hopes to obtain information that will allow it to provide the services needed most at more efficient levels of cost and energy consumption.

Radio stations WWV and WWVH, located at Fort Collins, Colo., and near Kekeha, Kauai, Hawaii, respectively, provide precise standard frequency, time signal and special announcement broadcasts to a large number of users. These services are used directly by about one million diversified consumers, including air and sea navigators, electrical utility companies, the communications industry, the military, jewelers, scientific and technological installations and amateur radio operators.

In 1974, a 50 percent power output reduction was proposed by NBS for radio station WWVH for the frequencies of 5, 10 and 15 MHz. However this action was not taken because of the many objections raised by users of WWVH. Completion of the following questionnaire by interested listeners of these stations will help NBS make the necessary changes with as little effect as possible on WWV and WWVH users.

All questionnaires should be returned to NBS by May 1, 1975.

# WWV/ WWVH Users Queried

## NBS Questionnaire for Users of WWV, WWVH Services

### 1. To what extent do you use the following frequencies?

	Frequently	Sometimes	Rarely	Never
2.5 MHz				
5				
10				
15				
20				
25				

### 2. How important are the following frequencies for your operation?

	Very Important	Somewhat Important	Relatively Unimportant	Very Unimportant
2.5 MHz				
5				
10				
15				
20				
25				





**National Bureau of Standards**  
Time and Frequency Division  
Boulder, Colorado 80302

**3. How often do you use the following?**

	Frequently	Sometimes	Rarely	Never
WWV				
WWVH				
Telephone No. (303) 499-7111				

**4. How often do you experience harmful interference between NBS broadcasts and other time/frequency transmissions? Check one:**

Never ☐ Seldom ☐ Often ☐ Frequently ☐

**5. In what approximate geographical area do you make use of WWV/WWVH signals?**

**6. To what extent do you use the following information?**

	Frequently	Sometimes	Rarely	Never
Time of day: voice				
Time of day: BCD code				
One-second ticks				
Standard frequency				
DUT 1 values				
Weather				
Geoalerts				
Propagation forecasts				

**7. How important for your operation is each of the following categories of information as supplied by WWV/WWVH?**

	Very Important	Somewhat Important	Relatively Unimportant	Very Unimportant
Time of day: voice				
Time of day: BCD code				
One-second ticks				
Standard frequency				
DUT 1 values				
Weather				
Geoalerts				
Propagation forecasts				

**8. How would you characterize the signal which is typical for you?**

	More Than Adequate	Adequate	Marginal	Useless
Signal strength				
Accuracy of Time and/or Frequency				

**9. Please check the categories in the two lists below which most accurately characterize your use of NBS frequency and time services.**

*User Classification*

- ☐ Gov't: Military
- ☐ Gov't: Civilian
- ☐ Equip. Manufacturing
- ☐ Navigation
- ☐ Aviation/Aerospace
- ☐ Telephone Industry
- ☐ Electric Power Industry
- ☐ Standards Lab
- ☐ Shipping/Boating Industry
- ☐ Pleasure Boating
- ☐ University
- ☐ Communications Industry
- ☐ Seismology/Geophysics
- ☐ Other (please specify) \_\_\_\_\_

*Principal Use*

- ☐ Hobby (other than amateur radio)
- ☐ Amateur Radio
- ☐ Calibration of Watches/Clocks
- ☐ Navigation/Position Location
- ☐ Communications Systems
- ☐ Scientific Data Monitoring
- ☐ Instrument Calibration
- ☐ Rocket/Satellite Tracking
- ☐ Storm Warnings
- ☐ Geoalerts
- ☐ Propagation Forecasts
- ☐ Astronomy
- ☐ Other (please specify): \_\_\_\_\_

**10. Are there other services we should add? Yes ☐ No ☐ If yes, what services?**

**11. Do your responses to the above *officially* represent more than your own personal involvements? Yes ☐ No ☐ If yes, please explain.**

**12. Comments:**



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*Publications listed here may be purchased at the listed price from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (foreign: add 25%). Microfiche copies are available from the National Technical Information Service, Springfield, Va. 22151. For more complete periodic listings of all scientific papers and articles produced by NBS staff, write: Editor, Publications Newsletter, Administration Building, National Bureau of Standards, Washington, D.C. 20234.*



